REMARKS

By this amendment, Applicants have amended the specification to correct idiomatic and typographical errors. Applicants have also amended the abstract to be in proper form and have amended the claims to further define their invention. In particular, claims 1 and 11 have been amended to recite that the range of C(carbon) is not less than 0.4 % to less than 1.3 %. This amendment is supported by, e.g., the description at page 20, lines 5-7 of Applicants' specification. Claims 1 and 11 have also been amended to recite that the amount of Al is 0.7 to 2.0 %. This amendment is supported by, e.g., the description at page 22, lines 3-5 and original claim 5. Claim 5 has been canceled and new claims 17-21 added to define further aspects of the present invention. These claims are supported by, e.g., page 26, line 26, to page 27, line 22; page 31, lines 10-13; page 38, lines 7-10 and page 44, lines 4-7 of Applicants' specification.

In view of the foregoing amendments to the abstract and specification, reconsideration and withdrawal of the objection to the disclosure of page 2 of the Office Action are requested.

Claims 1-3, 11 and 12 have been amended to eliminate the antecedent basis problems noted by the Examiner at the top of page 3 of the Office Action. Accordingly, it is submitted all of the claims now in the application comply with the requirements of 35 U.S.C. 112, second paragraph. Therefore, reconsideration and withdrawal of the rejection of claims 1-3, 11 and 12 under 35 U.S.C. 112, second paragraph, are requested.

Claims 1-9 and 11-15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over British specification number 1,482,724 to Beyer et al. Applicants traverse this rejection and request reconsideration thereof.

The present invention relates to a material for use as self-lubricating sliding parts and to a wire material for use as piston rings. These materials consist of steel comprising, by mass from not less than 0.4 % to less than 1.3 % of C(carbon), 0.1 to 3.0 % of Si, 0.1 to 3.0 % of Mn, from zero (inclusive) to 0.5 % of Cr, 0.05 to 3.0 % of Ni, 0.7 to 2.0 of Al, 0.3 to 20 % in total (Mo + W + V) of at least one element selected from the group consisting of Mo, W (tungsten) and V (vanadium), and 0.05 to 3.0 % of Cu. According to the present invention, graphite particles having an average particle size of not more than 3 μm in a section of a metal structure of the steel can be observed.

For making a self-lubricating sliding part, such is a piston, the steel is produced from an ingot through plastic working such as forging, drawing and/or rolling, and quenching/tempering heat treatment. This is distinguished from a casting material which is provided in final product form directly by casting.

The Beyer et al. published specification relates to a wear-resistant cast iron alloy suitable for the construction of machine parts subject to high frictional stressing. In Beyer et al., the cast iron alloy has a high content of carbon, i.e., 1.5 to 4.0 % by weight, e.g., 2.2 %, and a relatively high silicon content. With regard to silicon, the broad range stated in Beyer et al. is 1.5 to 6.0 by weight, but the example shows a cast-iron melt comprising 3.9 % by weight silicon. The high-content of carbon and relatively high content of silicon is necessary in a cast iron alloy in order to ensure a good fluidity in a moltened state. On the other hand, the material in the present invention consists of a steel comprising from not less than 0.4 % to less than 1.3 %

by mass of carbon. The material of the present invention is for use as self-lubricating sliding parts, e.g., for use as a piston ring and, therefore, is subject to a peculiar process including diffusion annealing. As noted in the paragraph bridging pages 19 and 20 of Applicants' specification, excess of carbon unfavorably lowers a melting temperature of carbides, so that the metal structure can hardly be austenite by diffusion annealing.

Regarding Si in the present invention, it must be limited to not more than 3.0 mass %, since it makes the A_1 point of steel higher, while a rise of the A_1 point impairs stability of austenite when heating the steel for quenching. See, page 20, lines 8-23 of Applicants' specification. When the stability of austenite is impaired, it is impossible to realize an enough martensitic metal structure. For the same reasons as in the case of Si, the Al content should be limited to not more than 2.0 mass %, while the Al content is required to be not less than 0.7 mass % since Al facilitates forming of graphite and is responsible for ensuring the steel hardness after nitriding treatment. See, the paragraph bridging pages 21 and 22 of Applicants' specification.

In Beyer et al., the carbon content is always higher than that of the steel of the present invention. Moreover, the example of cast-iron melt given in Beyer et al. has a higher silicon higher and a lower alumina content then that of the present invention. Since the Beyer et al. specification is directed to cast-iron, while the material of the present invention must have different characteristics so that it can be used as a self-lubricating sliding part, e.g., as a piston ring, it is submitted there would have been not apparent reason to modify the teachings of Beyer et al. to have a steel having the carbon content presently claimed. Moreover, the Beyer et al.

publication does not suggest the particular ranges of silicon and aluminum contents presently claimed.

With respect to claims 11-21, the wire material and piston ring made therefrom has sulfide inclusions observed in the section of the metal structure, parallel to the periphery of the piston ring, distributed such that straight lines each passing through a major axis of the respective sulfide inclusion cross one another within a cross angle of not more than 30 degrees, which angle is referred to as a degree of parallelism. On the other hand, since the alloy of Beyer et al. is cast, it is submitted the sulfide inclusions having the extended form claimed would not exist since it is not disclosed that the cast iron of Beyer et al. is subject to plastic working.

For the foregoing reasons, the presently claimed invention is patentable over Beyer et al.

Claims 10 and 16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Beyer et al. in view of the excerpt from the ASM Handbook, Volume 4. Applicants traverse this rejection and request reconsideration thereof.

The Examiner has cited the ASM Handbook, Volume 4, for its general teachings regarding gas nitriding. However, it is submitted nothing in this document remedies any of the basic deficiencies noted above with respect to Beyer et al. Accordingly, claims 10 and 16 are patentable over Beyer et al. and the ASM Handbook, Vol. 4, at least for the reasons noted above.

Claims 1-4 and 7-9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Japanese patent application publication number 07-188847 to Iwamoto et al. Applicants traverse this rejection and request reconsideration thereof.

The Iwamoto et al. document discloses steel having an aluminum content of 0.01 to 0.5 % by mass. On the other hand, according to the present invention, the

steel has aluminum content of 0.7 to 2.0 by mass. As noted in the paragraph bridging pages 21 and 22 of Applicants' specification, aluminum is an effective element for precipitation of fine graphite particles in a short time and is effective for raising the nitriding hardness to a suitable value. Such is neither disclosed nor suggested by Iwamoto et al. Moreover, there would have been no apparent reason to modify Iwamoto et al. since the steel of Iwamoto et al. is disclosed to be used as annealed and not subjected to the treatment of quenching and tempering. See, paragraph 0042-0044 of Iwamoto et al. Therefore, the aluminum content in Iwamoto et al. is decided with a view point different than the aluminum content of the present invention.

For the foregoing reasons, the presently claimed invention is patentable over Iwamoto et al.

Claim 10 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamoto et al. in view of ASM Handbook, Volume 4. Applicants traverse this rejection and request reconsideration thereof.

For the reasons noted above, it is submitted the ASM handbook, Volume 4, does not remedy any of the deficiencies noted above with respect to Iwamoto et al. Accordingly, claim 10 is patentable over the proposed combination of references, at least for the reasons noted above.

Claims 11-15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamoto et al. in view of U.S. Patent No. 2,014,440 to Lee. Applicants traverse this rejection and request reconsideration thereof.

The deficiencies of Iwamoto et al. are noted above. It is submitted the patent to Lee merely discloses a method of heat treating piston rings and does not remedy any of the deficiencies noted above with respect to Iwamoto et al. Accordingly,

claims 11-15 are patentable over the proposed combination of references, at least for the reasons noted above.

Claim 16 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamoto et al. in view of Lee and further in view of the ASM Handbook, Volume 4. Applicants traverse this rejection and request reconsideration thereof.

For the reasons noted above, the ASM Handbook, Volume 4, does not remedy any of the basic deficiencies noted above with respect to Iwamoto et al. and Lee. Accordingly, claim 16 is patentable over the proposed combination of references, at least for the reasons noted above.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 500.44577X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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